

## Nuclear Science Division Newsletter

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September, 2011

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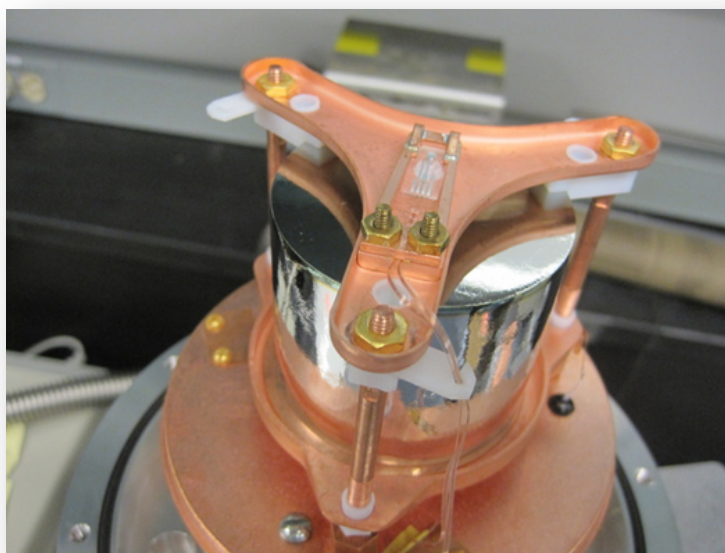
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### MAJORANA gets integrated

The MAJORANA DEMONSTRATOR experiment will deploy an array of germanium detectors enriched in  $^{76}\text{Ge}$  to search for neutrinoless double-beta decay at the Sanford Underground Laboratory. Observing neutrinoless double-beta decay would establish the Majorana nature of neutrinos and have a profound impact on our understanding of particle physics. The MAJORANA group in the Nuclear Science Division is responsible for the development of the germanium detector technologies, the readout electronics and signal processing for the experiment.

A significant milestone was recently reached by the group with the operation of a germanium detector using prototype components designed for the MAJORANA DEMONSTRATOR project. This detector unit used a germanium crystal prepared by the Semiconductor Detector Lab at LBNL. A copper mount designed for the MAJORANA experiment integrated the crystal with ultra-low-noise front-end electronics designed at LBNL and a low-background cable constructed at the University of Washington. The detector was mounted in a custom cryostat and read out with a preamplifier designed at LBNL. This was the first time that a germanium detector was operated using only components designed for the MAJORANA DEMONSTRATOR. The performance and electronic response comfortably met all of the design requirements.



Single detector unit showing the germanium crystal, copper mount, low-background prototype cable and front end electronics.

The next phase of prototyping at LBNL is to operate a string of several detector units. A new cryostat for this test is currently operating a single detector. The group is characterizing commercial germanium detectors that will be integrated into the new cryostat over the next few months. These tests will optimize the noise performance of the electronics design. Operating a string of detectors will be another significant milestone for the MAJORANA experiment and will show that the design is suitable for deploying a larger number of germanium detectors.

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### Carbon fiber lifts heavy quarks

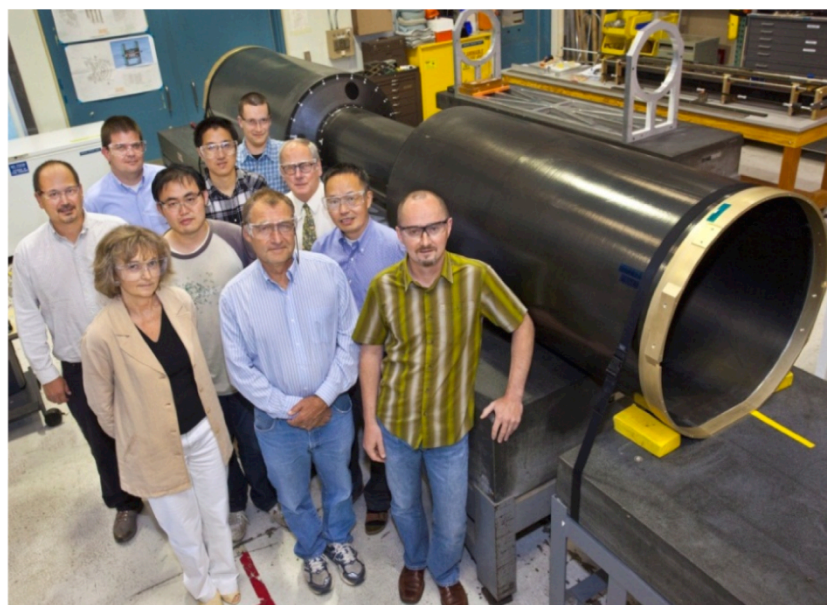
The tracking system of the STAR experiment at RHIC will soon be upgraded to be better able to study heavy quarks and other short-lived particles. A new inner tracker will be added, inside the main time projection chamber (also built at LBNL). A key feature of the new tracks is a new low radiation-length support system composed of very strong thin-wall ( $\sim 800 \mu\text{m}$ ) carbon fiber cylinders named the Inner Detector Support (IDS) system.

The IDS, seen here, will be the main mounting structure for the STAR Heavy Flavor Tracker (HFT) upgrade, a set of 3 silicon based detectors designed to significantly enhance the pointing resolution of the STAR detector. The support system was designed by Eric Anderssen and Joseph Silber of the Engineering Division, and constructed in LBNL's carbon-fiber shop. The 4-meter long support has already been shipped to Brookhaven and will be installed into the STAR detector next month. By using advanced composites technology, the IDS will be able to hold the 2 outer tracking detectors (located on the "waist" of the IDS structure) to a positional tolerance of  $\sim 100 \mu\text{m}$  while minimizing the amount of material in the tracking volume. The construction, delivery and installation of the support system is an important milestone for the HFT project, which is scheduled to be fully installed in 2013.

The HFT will be inserted into the core of the experiment between the TPC inner field cage and a new 2 cm radius beryllium beam pipe. The HFT will provide high-resolution vertex reconstruction for the STAR with a distance-of-closest-approach

resolution of  $< 50 \mu\text{m}$ . This will allow the selection of tracks from the displaced vertices produced when hadrons containing heavy quarks decay.

The HFT project is led by BNL. In addition to the IDS, LBNL is designing and building the two innermost layers, consisting of monolithic active pixel sensors and is also responsible for updating the existing Silicon Strip detectors. A third detector subsystem, based on silicon pad sensors was designed and is being built by MIT.



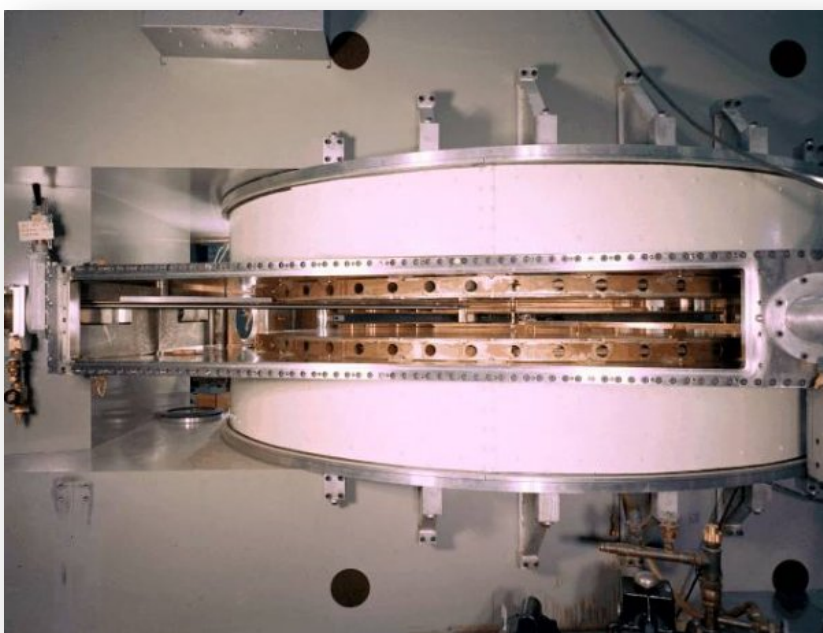
**The new Inner Detector Support system fabricated in the LBNL carbon-fiber shop. The group pictured are Eric Anderssen (Engineering Division), Howard Wieman, Grazyna Odyniec, Nu Xu, James Symons, Xiangming Sun, Leo Greiner, Xin Dong, Ernst Sichtermann and Michal Szelezniak.**

## Nuclear Science Division Newsletter

### Cold oven generates a hot accelerator beam

A new low-temperature oven was recently installed in the VENUS ion source making it possible to produce calcium beams at intensities much higher than has previously been delivered by the AECR ion source. This, together with improvements in the injection beam line transport efficiency, resulted in a record intensity of 1.8 pμA 200 MeV  $40\text{Ca}^{9+}$  ions leaving the cyclotron.

Further improvements of the ion sources, beam lines and the cyclotron are in progress. A new quadrupole magnet is being designed and constructed to allow for better focusing of the beams from VENUS. In addition, new cooling for the last solenoid magnet in the injection line is being implemented to better handle these more intense beams. A new beam buncher has also been manufactured and will be installed during the winter shutdown. It is expected that the cyclotron will be able to deliver  $48\text{Ca}^{11+}$  beams of similar or higher intensities during the spring of 2012 in support of the super-heavy element research program.

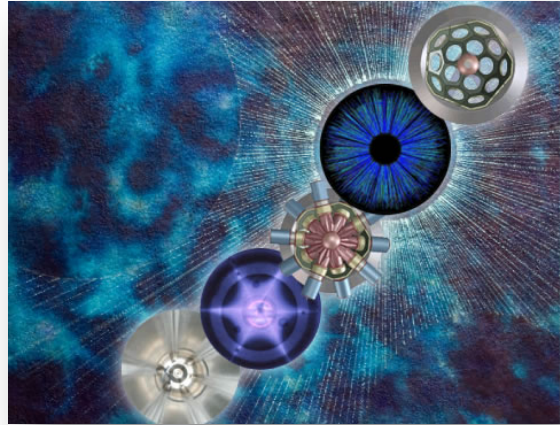


## Nuclear Science Division Newsletter

### NSD Fragments

The beginning of September marked several notable transitions:

Einstein Fellow **Ken Shen** joined the Nuclear Theory Group on September 16, where he will continue his work on thermonuclear processes in binary stellar systems. NASA's Einstein Program provides three-year fellowships to promising recent PhDs, allowing them to work at a host institution of their choosing.



**Dan Chivers** joined the Applied Nuclear Physics program as a Staff Scientist. Dan will work on gamma-ray imaging for a variety of applications.

**Yuan Mei** has joined the neutrino program as a postdoc, to work on CUORE. He received his PhD from Rice University, where he worked on the Xenon 100 experiment.

Project Scientist **Joanna Kiryluk** has left Berkeley, to accept a faculty position at Stony Brook. Fortunately, she will continue to work on IceCube, and will return to LBNL periodically as an affiliate.